Product rule, two functions

If a function contains two variable expressions that are multiplied together, you cannot simply take their derivatives separately and then multiply the derivatives together. You have to use the product rule. Here is the formula:

Given a function

$$h(x) = f(x)g(x)$$

then its derivative is

$$h'(x) = f(x)g'(x) + f'(x)g(x)$$

To use the product rule, multiply the first function by the derivative of the second function, then add the derivative of the first function times the second function to your result.

Example

Find the derivative of the function.

$$h(x) = x^2e^{3x}$$

The two functions in this problem are x^2 and e^{3x}. It doesn't matter which one you choose for $f(x)$ and $g(x)$. Let's assign $f(x)$ to x^2 and $g(x)$ to e^{3x}. The derivative of $f(x)$ is $f'(x) = 2x$. The derivative of $g(x)$ is $g'(x) = 3e^{3x}$.

According to the product rule,

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$$h'(x) = \left(x^2\right)\left(3e^{3x}\right) + (2x)\left(e^{3x}\right)$$

$$h'(x) = 3x^2e^{3x} + 2xe^{3x}$$

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